

A STUDY OF THE SYSTEMATIC AND GEOGRAPHIC DISTRIBUTION OF
THE DECAPOD FAMILY CRANGONIDÆ BATE.

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In a former paper¹ I gave in general terms the limits of the Indo-Pacific littoral region, to which I added a study of the origin of the recent littoral regions of the world. As these considerations, founded upon the geographical distribution of the Decapoda, contain but a few detailed investigations, it is necessary to go more into detail when a separate group of Decapoda is examined and to state the relations to the principles given in the paper quoted. In 1891 I revised the genera *Palaemon* and *Bithynis*² and gave an account of their geographical distribution. In 1894 I published an account of the family Atyidæ.³ These groups of fresh water crustacea are wholly unlike each other in respect to their geographical range and agree only in that they are true tropical animals. Whilst the *Palaemon* and *Bithynis* group of the Palaemonidæ is a very recent one, related in its distribution, without doubt, to the limits of the recent marine littoral regions, the family Atyidæ is comparatively an ancient one, showing in no way relations to the former.

In the present paper I will treat of a true marine group, the family of Crangonidæ, which is characterized by the adaptation of most of its members to the cold waters of the Arctic and deep sea regions.

Fossil remains of Crangonidæ are unknown. In all species referred with more or less doubt to this family, the typical characters are not evident. The absence of Crangonidæ from the Tertiary deposits agrees with their morphological characters and their supposed recent development. They form the most extreme end of one of the two main branches of the Eucyphidea.⁴ The principal character is the more or less reduced condition of the second pair of pereopoda. The

¹ Jenaische Denkschrift, VIII, 1894, p. 68 P. Crustaceen in Semon, Zoolog. Forschungsreisen in Australien und dem malayischen Archipel.

² Zoologische Jahrbücher, V, 1891, p. 693-750.

³ Proceed. Acad. Nat. Sci. Philadelphia, 1894, p. 397-416.

⁴ Ortmann, Zoolog. Jahrb., V, 1890, pp. 462, 463.

Crangonidæ are connected with the Nikidæ by the genus *Glyphocrangon*, but this connection is not a close one—there are some gaps.

Among the Crangonidæ, the genus *Pontocaris* is no doubt the most primitive in regard to the sculpture of the carapace; the number of gills and the shape of the second pair of pereopoda. From *Pontocaris* arise two divergent branches: the one through the subgenus *Scleroocrangon* to *Crangon*, ending in *Nectocrangon*, characterized by no shortening of the second pair of pereopoda, by the reduction of the number of gills, and by the surface of the body becoming gradually smoother. The other branch is represented by the genera *Pontophilus*, *Sabinea*, *Paracrangon*, characterized by the reduction of the second pair of pereopoda in length, by retaining the primitive number of gills and the sculpture of the body. In *Pontophilus* some species have the body more or less smooth. The genus *Prionocrangon* is an aberrant one, without eyes, but related probably to the genera *Pontophilus* and *Sabinea* of the second branch.

CRANGONIDÆ Bate, 1888.

Crangoninae Kingsley, Proceed. Acad. Nat. Sci. Philadelphia, 1879, p. 411.

Crangonidæ Bate, Challenger Macrur., 1888, p. 481, Ortmann, Zoolog. Jahrb., V, 1890, p. 462.

Mandibles simple, slender, incurved, not dilate or bifid, without a synnhipod. First pair of legs stouter than the second, hand subchelate, the dactylus closing on the margin of the palm, the pollex being spiniform. Second pair of legs very feeble, chelate, often shortened, not chelate, or wholly reduced. External maxillipeds pediform. Maxillæ with more or less reduced innermost parts. Rostrum mostly short.

a_1 . Second pair of legs present.

b_1 . Eyes present.

c_1 . Second legs not remarkably shortened (carpal joint and hand together longer than the merus). Gills seven on each side. Carapace with dentate longitudinal keels PONTOCARIS.

c_2 . Second legs not shortened. Gills five on each side.

d_1 . Eyes free. Dactyli of the two posterior pairs of legs not dilated CRANGON.

d_2 . Eyes nearly hidden by the frontal part of the carapace. Dactyli of the two posterior pairs of legs dilated, natatorial. NECTOCRANGON.

- c*₃. Second legs remarkably shortened (carpal joint and hand together not longer than the merus). Gills seven.⁵
- d*^l. Second legs chelate PONTOPHILUS.
- d*₂. Second legs not chelate SABINEA.
- b*₂. Eyes wanting. Second legs not chelate, rather robust, with fringes of long, plumose setæ. A spiny median crest on the carapace PRIONOCRANGON.
- a*₂. Several pairs of legs wholly obsolete. Rostrum elongated. PARACRANGON.

PONTOCARIS Bate, 1888.

Bate, Challenger Maerur. 1888, p. 495.

Very nearly allied to *Crangon*, especially to *Sclerocrangon*. Second pericopoda not remarkably shortened, carpus and palma together longer than the merus. Six pleurobranchiæ (i-o) and one podobranchia (h) present (see Bate, l. c., p. 496). Carapace with seven keels, the five uppermost dentate. Abdomen sculptured.

- a*₁. Anterior lateral angles of carapace projecting forward. Rostrum acuminate *P. propensalata*.
- a*₂. Anterior lateral angles of carapace obliquely directed outward and forward. Rostrum bidentate *P. pennata*.

1. Pontocaris propensalata Bate, 1888.

Bate, Challenger Maerur. 1888, p. 496, pl. 90, figs. 2, 3, pl. 85, fig. 5.

Geographical distribution: Ki Island, near New Guinea, 140 fath. (Bate).

2. Pontocaris pennata Bate, 1888.

Bate, *ibid.*, p. 499, pl. 91.

Geographical distribution: Arafura Sea, 49 fath. (Bate).

CRANGON Fabricius 1798 (restrict).

Fabricius, Suppl. Entomol. Syst., 1798, p. 409 (pr. part). Kingsley, Proceed. Acad. Nat. Sci. Philadelphia, 1879, p. 412.

Second pericopoda not remarkably shortened, with chelæ. Eyes present, free. Five gills present: four pleurobranchiæ (l. m. n. o.), one arthrobranchia (k).⁶

⁵ The number of gills has not been examined in all species. I found five gills in: *Crangon boreas*, *salebrosus*, *intermedius*, *typicus*, *affinis*, *franciscorum*, *Nectocrangon lar*, and seven in *Pontophilus norvegicus*, *Sabinea septemcarinata*. By other authors (Bate, Smith) are recorded five in *Crangon agassizi*, and seven in *Pontocaris propensalata*, *pennata*, *Pontophilus brevisrostris*, *abyssi*, *challengeri*, *Sabinea hystrix*.

⁶ Smith records in *Cr. agassizi* a pleurobranchia on k, but no arthrobranchia. The branchial formula given by Bate (l. c., p. 482) is certainly wrong.

G. O. Sars creates for some species the genus *Sclerocrangon*. I can not adopt this genus, but I retain it as a subgenus.

- a*¹. Carapace strongly sculptured, at least two spines in the median line. Abdomen mostly strongly sculptured, seldom nearly smooth.
 Subgenus: *SCLEROCRANGON*.
- b*₁. Median keel of carapace with three or four spines. Lateral keels of carapace partly granulate or rugose. Abdomen sculptured by longitudinal keels and transverse furrows.
- c*₁. Epimera of the abdominal segments provided with spines. Carapace with more than three keels. Spines not excessively developed. Sternum with a sharply serrated keel.
- d*₁. Keels of the carapace sharply granulated, keels of the abdomen sharp, epimera of the abdominal segments with one to three spines.
- e*₁. The rostrum is simple *Cr. salcbrosus* (1)⁷.
- e*₂. A long acute tooth is given off from the lower side of rostrum, which reaches as far forward as the tip of the rostrum *Cr. atrox*.
- d*₂. Keels of the carapace somewhat rugose, keels of the abdomen not sharp, epimera of the abdominal segments only with one spine each *Cr. borcas* (14).
- c*₂. Epimera of the abdominal segments without spines. Carapace with three keels, the median one with four very long spines. Sternum with a dentated keel *Cr. sharpi* (2).
- b*₂. Median keel of carapace with two spines. Lateral keels of carapace smooth, ending in front in the usual spines. Abdomen smooth, or with smooth longitudinal keels.
- c*₁. Epimera of the first and second abdominal segments with small spinules. Abdomen with longitudinal keels. Often a rudimentary third median spine in the median line of carapace between the two well-developed ones.
 *Cr. agassizi*.
 *Cr. procax*.
- c*₂. Epimera of abdomen without spinules. Median spines of carapace small.
- d*₁. Abdomen with longitudinal median keels.
- e*₁. Sixth abdominal segment with two sharp keels.
 *Cr. intermedius* (2).
- e*₂. Keel of the sixth abdominal segment behind the middle finely furrowed *Cr. angusticauda* (4).
- d*₂. Abdomen not sculptured *Cr. munitus*.
- a*₂. Carapace not sculptured, only with one median, and mostly with one lateral spine on each side (the latter being absent in *Cr. capensis*). Abdomen nearly smooth Subgenus: *CRANGON*.

⁷ I put in parentheses, following each species, the number of specimens I have examined myself.

- b*₁. Carapace with three spines: one in the median line, and two laterals.
- c*₁. Fifth segment of the abdomen on the posterior margin without spines. Hand more stout, about three times as long as broad *Cr. erangon*.

SUBSPECIES.

- d*₁. All segments of the abdomen rounded dorsally.
. *Cr. erangon* (many).
- d*₂. Some of the posterior segments of the abdomen sculptured.
- e*₁. Fourth and fifth segments (seldom also the third) with a feeble longitudinal keel, sixth and seventh feebly furrowed.
. *Cr. erangon affinis* (many).
- e*₂. Third to fifth segment without keels, sixth with two distinct keels, seventh furrowed . . . *Cr. erangon allmanni* (1).
- c*₂. Fifth segment of the abdomen on the posterior margin, near the median line, with a posteriorly projecting spine on each side.
- d*₁. Hand more slender, about four times as long as broad. Abdominal segments rounded above . *Cr. franciscorum* (many).
- d*₂. Hand more stout, about three times as long as broad. Sixth and seventh segment of abdomen furrowed.
. *Cr. antarcticus*.
- b*₂. Carapace only with a spine in the median line, the lateral ones wanting *Cr. capeensis*.

Subgenus **SCLEROCRANGON** G. O. Sarr, 1885.

G. O. Sars, Den Norsk. Nordhavs Exped., Zool., Crust. I, 1885, p. 14.

1. *Crangon* (*Sclerocrangon*) *salebrosus* Owen, 1839.

Crangon salebrosus Owen, Crust. Zool. Beechey's Voy. Blossom, 1839, p. 88, pl. 27, fig. 1. Stimpson, Proc. Acad. Nat. Sci. Philadelphia, 1860, p. 25. Kingsley, Bull. Essex Instit., 14, 1882, p. 129. Stuxberg, Vega. Exped. V, 1887, p. 53.

Cheraphilus ferox G. O. Sars, Arch. Mathem. Naturvid. II, 1877, p. 339.

Sclerocrangon salebrosus (Ow.) G. O. Sars, Den Norsk. Nordh. Exped., Zool., Crust. I, 1885, p. 15, pl. 2.

Geographical distribution: Northern circumpolar.—Kamschatka (Owen): Avatska Bay, 10 fath. (Stimpson), Spitzbergen, Jan. Mayen; off Norway, 100–459 fath. (G. O. Sars), Kara Sea, 55–60 fath. (Stuxberg).

2. *Crangon* (*Sclerocrangon*) *atox* Faxon, 1893.

Faxon, Bull. Mus. Comp. Zool. 24, 1893, p. 199.

Geographical distribution: Western coast of Mexico, 660–676 fath. (Faxon).

3. Crangon (*Sclerocrangon*) *boreas* (Phipps) 1774.

Cancer boreas Phipps, Voy. North Pole, 1774, p. 190, pl. 12 fig. 1.

Cancer homaroides Fabricius, Faun. Grönland, 1780, p. 241.

Astacus boreas (Ph.) Fabricius, Entomol. Syst., II, 1793, p. 483.

Crangon boreas (Ph.) Fabricius, Suppl. Ent. Syst. 1798, p. 409. Sabine, Suppl. Append. Parry's first Voy. 1824, 235. Milne-Edwards, Hist. Nat. Crust. II, 1837, p. 342. Kroyer, Naturh. Tidsskr., IV, 1842, p. 218, pl. 4, figs. 1-14. Milne-Edwards, Atlas. Cuvier, Regn. Anim. pl. 51, fig. 2. (no date). Brandt, Krebse, in Middendorff's Siber. Reis., II, Zool. 1851, p. 114. Danielssen, Beretn. Zool. Reise, 1859, p. 4. Stimpson, Proceed. Acad. Nat. Sci. Philadelphia, 1860, p. 25. Buchholz, Zweite Deutsch. Nordpol. II, 1874, Crust. p. 271. Kingsley, Bull. Essex Inst. X, 1878, page 54. Smith Trans. Conn. Acad., V, 1879, p. 56. Stuxberg, Vega Exped., V, 1887, p. 53.

Cheraphilus boreas (Ph.) Miers, Annal. Magaz. Nat. His. (4) XX, 1877, p. 57. Hoek, Nederl. Arch. Zool., Suppl. 1, 7, Crust. 1882, p. 10. Murdoch, Rep. Pol. Exped. Point Barrow. 1885, p. 139.

Crangon (*Cheraphilus*) *boreas* (Ph.) Miers, Jour. Linn. Soc., Zool. XV, 1881, p. 60.

Sclerocrangon boreas (Ph.) G. O. Sars, Christiania Vid. Selsk. Forh. 1882, p. 7. G. O. Sars, Den Norsk. Nordh. Exp. Zool. Crust. II, 1886, p. 6. Koelbel, Die Oesterr. Polarst., Jan Mayen, III, 1886, Zool. E. p. 51. Ortmann, Zool. Jahrb. V, 1890, p. 532.

Geographical distribution: Northern circumpolar. Norway (Danielssen, G. O. Sars) Barents Sea and Nowaja Semlja, 25-140 fath. (Hoek); Franz Joseph Land (Miers); Beeren Island (G. O. Sars); Spitzbergen, shallow water (Hoek, G. O. Sars) Jan Mayen (Kölbel); Iceland (Krøyer); east coast of Greenland, 4-27 fath. (Buchholz); west coast of Greenland, to 87° 44' lat. northward (Miers); Davis Strait and Melville Island (Sabine); N. E. coast of America, from Labrador to Massachusetts Bay, 5-33 fath. (Smith); northern coast of America to Berings Strait, 10-26 fath. (Stimpson); Alaska: Point Franklin, 13 fath. and Port Clarence (Murdoch); Siberia (Brandt, Stuxberg).

4. Crangon (*Sclerocrangon*) *sharpi* nov. spec.⁸

Paracrangon echinatus Sharp (non Dana), Proceed. Acad. Nat. Sci., Philadelphia, 1893, p. 126.

⁸ *Description:* Carapace with three keels, the median one with four long spines, the first longest and placed on the upper margin of rostrum, which extends a little beyond the eyes; the second spine nearly as long as the first, placed immediately behind the base of the rostrum. The spines are directed obliquely forward and upward. Lateral keels formed by four spines, the foremost, on the anterior margin of carapace near the base of antennæ, is the longest, and directed obliquely forward and outward, more than half as long as the carapace; the three others are smaller, but sharp. Abdomen sculptured, first to sixth segment with a median keel, that of the third arched and produced somewhat posteriorly, that of the sixth finely furrowed and ending in two spines posteriorly. Two other spines are placed at the posterior margin of this segment, one on each side. Fifth segment, on the posterior margin, near the median line, with a sharp spine on each side. Lateral faces of the first to fifth segment sculptured by two irregular transverse furrows, sixth segment laterally with an indistinct longitudinal ridge. Epimera of the first to fourth segment triangular, inferior angles blunt, without spines. Keel of sternum dentate, but not spinoso-serrate.

Two specimens are in the Museum of the Academy of Natural Science of Philadelphia.

Geographical distribution: Alaska, Kodiak Archip.: Marmot Isle, 45 fath. (Sharp).

5. *Crangon (Sclerocrangon) agassizi* (Smith), 1882.

Cheraphilus agassizi Smith, Bull. Mus. Compar. Zool., Cambridge, X, 1882, p. 32, pl. 7, fig. 4, 5. Rep. U. S. Fish Comm. for 1882, 1884, p. 362.

Geographical distribution: Atlantic, eastern coast of United States, 31–41° N. Lat., 65–78° W. Long., 263–959 fath. (Smith).

6. *Crangon (Sclerocrangon) procax* Faxon, 1893.

Faxon, Bull. Mus. Comp. Zool., Cambridge, XXIV, 1893, p. 199.

Geographical distribution: Western coast of Central America: Gulf of California to Panama Bay, 660 to 905 fath. (Faxon.)

7. *Crangon (Sclerocrangon) intermedius* Stimpson, 1860.

Crangon intermedius Stimpson, Proceed. Acad. Nat. Sci., Philadelphia, 1860, p. 25.

Crangon tenuifrons Kingsley, Bull. Essex Inst., 14, 1882, p. 128, pl. 1, fig. 10.

Geographical distribution: Bering Sea, Cape Chepoonski, 40 fath. (Stimpson); Alaska: Marmot Isl. (Kingsley).

8. *Crangon (Sclerocrangon) angusticauda* de Haan, 1849.

Crangon angusticauda de Haan, Faun. Japon. Crust. Dec., 6, 1849, p. 183, pl. 45, fig. 15. Stimpson, Proceed. Acad. Nat. Sci., Philadelphia, 1860, p. 25.

Sclerocrangon angusticauda (d. H.) Ortmann, Zoolog. Jahrb., V, 1890, p. 533.

Geographical distribution: Japan, (de Haan): Simoda and Hakodati, sublittoral (Stimpson), Kadsiyama (Ortmann).

9. *Crangon (Sclerocrangon) munitus* Dana, 1852.

Crangon munitus Dana, U. S. Explor. Exped. Crust., 1852, p. 536, pl. 33, fig. 5. Stimpson, Boston Jour. Nat. Hist., VI, 1857, p. 497. Kingsley, Bull. Essex Inst. X, 1878, p. 54. Lockington, *ibid.* p. 159.

Geographical distribution: Puget Sound (Dana); Lower California: Magdalena Bay (Lockington).

Subgenus CRANGON.

10a. *Crangon crangon* (Linnaeus), 1758.

Cancer crangon Linnaeus, Syst. Nat., 10 ed., 1758, p. 632.

Astacus crangon (L.) Fabricius, Entomol. Syst., II, 1793, p. 486.

Cancer (Astacus) crangon L. Herbst, Krabb. u. Krebse, II, 1796, p. 75, pl. 29, fig. 3, 4.

Crangon vulgaris Fabricius, Suppl. Ent. Syst. 1798, p. 410. Leach, Malac. Podophth. Brit. 1815, pl. 37 B. Milne-Edwards, Hist. Nat. Crust. II, 1837, p. 341 and Atlas in Cuvier, Regn. Anim. pl. 51, fig. 1, (no date). Kroyer, Naturh. Tidsskr., IV, 1842, p. 239, pl. 4, fig. 29–33. Bell, Brit. Crust. 1853, p. 256. Kinahan, Proceed. R. I. Acad. Dublin, 1862, p. 68, 71, pl. 4. Heller, Crust. südl. Europ. 1863, p. 226, pl. 7, fig. 89. Meinert, Naturh. Tidsskr. (3) XI, 1877, p. 198. Kingsley, Bull. Essex Inst., X, 1878, p. 53. Kingsley, Proceed. Acad. Nat. Sci., Philadelphia, 1878, p. 89, *ibid.* 1879, p. 411. Smith, Trans. Connecticut Acad. V, 1879, p. 55. Kingsley, Bull. Essex

Inst. XIV, 1882, p. 129, pl. 1, fig. 5. Carus, Prodrum. faun. mediterr. I, 1854, p. 482. Henderson, Decap. and Schizop. Crust. Firth of Clyde, 1886, p. 32. Bate, Challenger Macrur. 1888, p. 484. Ortmann, Zool. Jahrb. V, 1890, p. 530.

Crangon rubropunctatus Risso, Hist. Nat. Crust. Nice, 1816, p. 83. Risso, Hist. Nat. Europ. merid. V, 1826, p. 65.

Crangon septemspinus Say, Jour. Acad. Nat. Sci., Philadelphia, I, 2, 1818, p. 246. DeKay, Zool. New York, Crust. 1844, p. 25, pl. 8, fig. 24.

Crangon maculosus Rathke, Mem. Acad. St. Petersburg, Sav. étr., III. 1837, p. 366.

Geographical distribution: Northern circumpolar (?), but more boreal than arctic, extending considerably southward. Northern Atlantic: European coasts, northward to Iceland, and northeastern coast of America, southward to Virginia and N. Carolina. Northern Pacific: Japan, Yokosuka (Bate) and Bay of Tokio (Ortmann). Litoral, very shallow water.

10b. *Crangon crangon affinis* de Haan, 1849.

Crangon vulgaris Owen, Crust. Zool. Becchey's Voy. Blossom, 1839, p. 87. Dana, U. S. Explor. Exped. Crust. 1852, p. 536. Murdoch, Rep. Pol. Exped. Point Barrow, 1885, p. 138.

Crangon affinis de Haan, Faun. Japon. Crust. Dec. 6, 1849, p. 183. Bate, Challenger Macrur. 1888, p. 484, pl. 86, fig. 1-3. Ortmann, Zoolog. Jahrb. V, 1890, p. 531.

Crangon nigricauda Stimpson, Proceed. Calif. Acad. Sci., I, 2, 1856, p. 89. Stimpson, Boston Jour. Nat. Hist. VI, 1857, p. 496, pl. 22, fig. 6., Stimpson Proceed. Acad. Nat. Sci., Philadelphia, 1860, p. 25. Kingsley, Bull. Essex Inst. X, 1878, p. 54. Lockington, *ibid.* p. 159.

Crangon propinquus Stimpson, Proceed. Acad. Nat. Sci., Philadelphia, 1860, p. 25.

Crangon nigromaculata Lockington, Proceed. Calif. Acad. Sci., III, 1876, p. 34.

Crangon alaskensis Lockington, *ibid.*

Geographical distribution: Northern Pacific, somewhat deeper water. Japan (de Haan): Kobe Bay and Inland Sea, 15-50 fath. (Bate), Maizuru (Ortmann), northern Japan, 4-20 fath. (Stimpson); Alaska: Mutiny Bay (Lockington), Norton Sound, 5 fath. (Murdoch); Puget Sound (Dana); Mouth of Columbia river (Stimpson); California, in deeper water than *Cr. franciscorum* (Stimpson): Tomales Bay (Stimpson), San Francisco (Dana, Stimpson), Monterey (Owen), San Diego (Lockington).

10c. *Crangon crangon allmanni* Kinahan, 1862.

Crangon allmanni Kinahan, Proceed. R. I. Acad., Dublin, VIII, 1862, pp. 68, 71, pl. 4. Kinahan, Trans. R. I. Acad. Vol. 24, 1871, p. 64. Metzger, Jahresber. Commiss. Unters. deutsch. Meere. II, 111, 1875, p. 290. Meinert, Naturh. Tidsskr. (3) XI, 1877, p. 198. G. O. Sars, Arch. Math. Naturv. II, 1877, p. 339. G. O. Sars, Christiania Vid. Selsk. Forh. 1882, p. 44. G. O. Sars, Den Norsk. Nordh. Exp., Zool., Crust II, 1886, p. 6. Henderson, Decap. Schiz. Crust. Firth of Clyde, 1886, p. 33. Ortmann, Zoolog. Jahrb. V. 1890, p. 532. Scott, Annal. Mag. Nat. Hist. (6) XIII, 1894, p. 413.

Geographical distribution: Northern Europe, somewhat deeper

water. England and Ireland (Kinahan); Scotland, 24-69 fath. (Metzger); Shetland Isl. (Kinahan); North Sea, 9-20 fath. (Metzger, Scott); Skagerrak and Kattegat, 6-49 fath. (Metzger, Meinert); Norway (G. O. Sars); Iceland, 20-30 fath. (G. O. Sars).

11. *Crangon franciscorum* Stimpson, 1856.

Stimpson, Proceed. Calif. Acad. Sci., I, 2, 1856, 89. Stimpson, Boston Journ. Nat. Hist. VI, 1857, p. 495, pl. 22, fig. 5. Stimpson, Proceed. Acad. Nat. Sci., Philadelphia, 1860, p. 25. Kingsley, Bull. Essex Inst. X, 1878, p. 54.

Geographical distribution: W. coast of N. America, shallow water. Puget Sound, Shoalwater Bay, Tomales Bay, San Francisco, Monterey (Stimpson).

12. *Crangon antarcticus* Pfeffer, 1887.

Pfeffer, Naturh. Mus. Jahrb., Hamburg. wiss. Anstalt. IV. 1887, p. 45, pl. 1, fig. 1-21.

Geographical distribution: South Georgia, (Pfeffer).

13. *Crangon capensis* Stimpson, 1860.

Stimpson, Proceed. Acad. Nat. Sci., Philadelphia, 1860, p. 24.

Geographical distribution: Cape of Good Hope, Simons Bay, 12 fath. (Stimpson).

NECTOCRANGON Brandt, 1837.

Argis Krøyer, Naturh. Tidsskr. IV, 1842, p. 267 (nomen præoccupatum).
Nectocrangon Brandt, Krebse in: Middendorff's Siber. Reis. II, Zool. I, 1851, p. 114. Kingsley, Proceed. Acad. Nat. Sci., Philadelphia, 1879, p. 412.

Second pereopoda not shortened, with chela. Five branchiæ, like *Crangon*. Eyes partly concealed by the frontal margin. Posterior pereopoda with lanceolate dactyli with fringes of hair.

a₁. Behind the rostrum two spines in the median line of carapace.

..... *N. lar* (4).

a₂. Behind the rostrum three well developed spines in the median line of carapace, between the rostrum and the first spine a rudimentary one

..... *N. alaskensis* (1).

1. *Nectocrangon lar* (Owen) 1839.

Crangon lar Owen, Zool. Beechey's Voy. Blossom, 1839, p. 88, pl. 28, fig. 1.
Argis lar (Ow.) Krøyer, Naturh. Tidsskr. IV, 1842, p. 255, pl. 5, fig. 45-62.
Nectocrangon lar (Ow.) Stimpson, Proceed. Acad. Nat. Sci. Philadelphia, 1860, p. 25. Stimpson, Annal. Lye. New York, X, 1874, p. 125. Kingsley, Bull. Essex Inst. X, 1878, p. 55. Smith, Trans. Connect. Acad. V, 1879, p. 61. Murdoch, Rep. Pol. Exped. Point Barrow, 1885, p. 139.

Geographical distribution: Northern circumpolar.—Arctic Ocean

(Owen, Stimpson); Northern Alaska: Point Barrow (Murdoch); Bering Strait: Avatska Bay, 10–20 fath. (Stimpson); Greenland: Godthaab (Kröyer); Labrador, (Smith); Gulf of St. Lawrence (Smith); New Foundland: St. Johns (Stimpson); Nova Scotia, 59 fath.; Halifax, 26–52 fath. (Smith).

2. *Nectocrangon alaskensis* Kingsley, 1882.

Kingsley, Bull. Essex Inst. XIV, 1882, p. 128.

Geographical distribution: Alaska, Kodiak Arch.: Marmot Island (Kingsley).

PONTOPHILUS Leach, 1815.

Pontophilus Leach, Melacostr. Podophth. Brit. 1815, pl. 37 A.

Egeon Risso (pr. part.) Hist. Nat. Europe mérid., V. 1826, p. 58.

Cheraphilus and *Aegeon* Kinahan, Proceed. R. I. Acad., Dublin, VIII, 1862, p. 68, 69.

Second periopoda shortened, carpal joint and hand together not longer than merus, chelæ present. Eyes present, free. Gills seven on each side: six pleurobranchiæ (i. k. l. m. n. o.) and one (rudimentary) podobranchia (h.).

*a*₁. Median keel of carapace with more than three spines. Seven keels on the carapace, with numerous teeth. Abdomen strongly sculptured.

*b*₁. Rostrum emarginate *P. cataphractus* (4).

*b*₂. Rostrum acute, with lateral teeth *P. bengalensis*,
P. andamanensis.⁹

*a*₂. Median keel of carapace with three spines. Abdomen smooth or only the posterior segments with longitudinal keels.

*b*₁. Carapace with more than two lateral spines. Abdominal segments with distinct keels.

*c*₁. Three denticulate lateral keels on each side. Fifth segment of abdomen with a keel. Rostrum acute, simple. *P. echinulatus*.

*c*₂. Two lateral keels on each side, the upper with three, the lower with two spines. Third and fourth segment of abdomen with a simple keel, fifth with four, sixth with two keels. Rostrum with lateral teeth *P. spinosus* (3).

*c*₃. Two lateral keels, the upper with two, the lower with one spine.

*d*₁. Sixth segment of abdomen with a double keel. Rostrum without lateral teeth *P. norvegicus* (4).

*d*₂. Fifth segment of abdomen with four, sixth with two keels. Rostrum with lateral teeth *P. lrcvirostris*.

⁹ I am not sure whether these two species (*bengalensis* and *andamanensis*) really belong to *Pontophilus*.

- b*₂. Carapace with two lateral spines and a third very small one behind the supraorbital fissure. Rostrum with two minute lateral teeth on each side. Abdomen smooth. Eyes colorless. *P. abyssi*.
P. occidentalis.
- b*₃. Carapace with two indistinct lateral keels, each with a spine. Sixth and seventh segments of abdomen feebly furrowed. Rostrum acute, with a lateral tooth on each side. *P. challengerii* (2).
- b*₄. Carapace with one lateral spine and a series of small spinules. Fifth segment of abdomen sculptured, sixth and seventh furrowed. Rostrum obtuse. *P. pattersoni*.
- a*₃. Median keel of carapace with two spines.
- b*₁. Abdomen strongly longitudinally and transversely sculptured. Carapace with a two-spined median keel, and two many-spined lateral ones on each side. Rostrum emarginate. . . . *P. sculptus*.
- b*₂. Abdomen smooth or only with a few longitudinal keels.
- c*₁. Carapace with distinct and denticulate lateral keels.
- d*₁. Three lateral keels, the upper with two, the lower with one, the middle without teeth. Rostrum truncate. *P. bidentatus*.
- d*₂. Two lateral keels, the upper with five, the lower with three teeth. *P. australis*.
- c*₂. Carapace with two lateral spines. Rostrum acute, slender. Abdomen without keels.
- d*₁. Rostrum without lateral teeth. *P. junceus*.
- d*₂. Rostrum with one lateral tooth on each side. Spines of the lateral faces of carapace in an oblique plane. . . . *P. gracilis*.
- d*₃. Rostrum with two lateral teeth on each side. Spines of the lateral faces of carapace in the same level. . . . *P. profundus*.
- c*₃. Carapace without lateral spines and without distinct keels. Rostrum short, obtuse, fifth and sixth segments of abdomen with two longitudinal keels. *P. bispinosus* (1).
- a*₄. Median keel of carapace with one spine. Abdomen smooth.
- b*₁. Carapace with three lateral spines and a longitudinal series of small spinules. *P. intermedius*.
- b*₂. Carapace with one spine on each side. . . . *P. trispinosus* (1).
- b*₃. Carapace without lateral spines.
- c*₁. Rostrum broadly truncate. Telson furrowed. *P. fasciatus* (5).
- c*₂. Rostrum short, obtuse. Telson rounded dorsally.
. *P. neglectus*.
- a*₅. Median line of carapace without spines. Carapace with seven keels, keels smooth, the upper and lower lateral keel with a spine each. Abdomen sculptured by transverse furrows. *P. carinicauda*.

1. *Pontophilus cataphraetus* (Olivi) 1792.¹⁰

Cancer cataphraetus Olivi, Zool. Adriat., 1792, p. 50, pl. 3, fig. 1.

¹⁰ Recently there has been described a species by Henderson (Trans. Linn. Soc. London, Zool. (2) V, part 10, 1893, p. 446, pl. 40, fig. 16, 17) from the Burmese coast named *Aegeon orientalis*, which is said to be nearly related to the Mediterranean *P. cataphraetus*.

Egeon loricatus Risso, Hist. Nat. Europ. mérid., V, 1826, p. 58.

Crangon cataphractus (Oliv.) Milne-Edwards, Hist. Nat. Crust., II, 1837, p. 343, and Atlas in Cuvier, Regn. anim. pl. 51, fig. 3 (no date). Heller, Crust. südl. Europ., 1863, p. 230, pl. 7, fig. 12-15. Miers, Annal. Mag. Nat. Hist. (5) VIII, 1881, p. 365. Carus, Prodrom. faun. mediterr., I, 1884, p. 482.

Aegeon cataphractus (Oliv.) Ortmann, Zoolog. Jahrb., V, 1890, p. 535.

Geographical distribution: Mediterranean Sea (Risso, Milne-Edwards, Heller, Carus); Senegambia (Miers).

2. *Pontophilus bengalensis* (Wood-Mason and Alcock) 1891.

Crangon bengalensis Wood-Mason and Alcock, Ann. Mag. Nat. Hist. (6) VIII, 1891, p. 369. Alcock and Anderson, Journ. Asiat. Soc. Bengal, vol. 63, 2, 1894, p. 152.

Geographical distribution: Indian Seas, 107-276 fath. (Wood-Mason, Alcock, Anderson).

3. *Pontophilus andamanensis* (Wood-Mason and Alcock) 1891.

Crangon andamanensis Wood-Mason and Alcock, *ibid.*

Geographical distribution: Indian Seas, 188-220 fath. (Wood-Mason and Alcock).

4. *Pontophilus echinulatus* (M. Sars) 1861.

Crangon echinulatus M. Sars, Forh. Vid. Selsk., Christiania, 1861, p. 29, pl. 3, fig. 48-64. G. O. Sars, Arch. Math. Naturv., II, 1877, p. 339. Henderson, Decap. Schiz. Firth of Clyde, 1886, p. 33.

Crangon serratus Norman, Rep. Brit. Assoc., 31 meet., 1862, p. 151. Norman, *ibid.*, 38 meet., 1869, p. 265.

Cheraphilus echinulatus (M. Sars), G. O. Sars, Forh. Vid. Selsk., Christiania, 1867, No. 18, p. 44. G. O. Sars, Den Norsk. Nordh. Exped., Zool., Crust., II, 1886, p. 7.

Geographical distribution: Norway, 80-150 fath. (M. Sars, G. O. Sars); Shetland Islands (Norman); Scotland: Loch Fyne, 105 fath. (Henderson).

5. *Pontophilus spinosus* Leach, 1815.

Pontophilus spinosus Leach, Malacostr. Podophth. Brit., 1815, pl. 37, A. Ortmann, Zoolog. Jahrb., V, 1890, p. 534.

Crangon cataphractus Milne-Edwards, Hist. Nat. Crust., II, 1837, p. 343 (pro parte).

Crangon spinosus (Leach), Bell, Brit. Crust., 1853, p. 261. Heller, Crust. südl. Europ., 1863, p. 229, pl. 7, fig. 16. Carus, Prodrom. faun. mediterr., I, 1884, p. 482. Henderson, Decap. Schiz. Firth of Clyde, 1886, p. 32.

Geographical distribution: European Seas. — From Norway and Sweden to the Mediterranean Sea, to about fifty fath. (see Ortmann, l. c.).

6. *Pontophilus norvegicus* (M. Sars) 1861.

Crangon norvegicus M. Sars, Forh. Vid. Selsk., Christiania, 1861, p. 183. M. Sars, Nyt. Magaz. f. Naturvid. 1861, p. 248. Goes, Öfv. K. Vet. Akad. Forh., 1863, p. 173.

Pontophilus norvegicus (M. S.) Meinert, Naturh. Tidsskr. (3) XI, 1877, p. 200. Smith, Trans. Connecticut Acad., V, 1879, p. 60. G. O. Sars, Forh. Vid. Selsk., Christiania, 1882, No. 18, p. 7. Smith, Bull. Mus. Compar. Zool., Cambridge, X, 1882, p. 34. G. O. Sars, Den Norsk. Nordh. Exp. Zool. Crust., II, 1886, p. 7. Ortmann, Zoolog. Jahrb., V, 1890, p. 534.

Geographical distribution: Northern Atlantic.—Sweden: Bohuslän (Goës); Skagerrak, 320 fath. (Meinert); Norway, 30–500 fath. (M. Sars, G. O. Sars); Spitzbergen Sea (G. O. Sars); N. E. coast of America: Nova Scotia, 101–110 fath., Gulf of Maine, 115 fath., off Cape Cod, 105–524 fath. (Smith).

7. *Pontophilus brevisrostris* Smith, 1881.

Smith, Proceed. U. S. Nation. Mus., III, 1881, p. 435. Smith, Bull. Mus. Compar. Zool. X, 1882, p. 35, pl. 7, fig. 1. Smith, Rep. U. S. Fish Com. for 1882–1884, p. 362.

Geographical distribution: Atlantic, eastern coast of United States, 51–155 fath. (Smith).

8. *Pontophilus abyssi* Smith, 1884.

Smith, Rep. U. S. Fish Com. for 1882–1884, p. 363. Wood-Mason and Alcock, Annal. Mag. Nat. Hist. (6) VIII, 1891, p. 361.

Geographical distribution: Atlantic, off the coast of United States, 37° N. Lat., 70° W. Long., 1917–2221 fath. (Smith); Bay of Bengal, 1748–1997 fath. (Wood-Mason and Alcock).

9. *Pontophilus occidentalis* Faxon, 1893.

Faxon, Bull. Mus. Compar. Zool., XXIV, 1893, p. 200.

Geographical distribution: Off the western coast of Central America, 978–2232 fath. (Faxon).

10. *Pontophilus challengerii* Ortmann, 1893.

Pontophilus gracilis Bate, Challenger Macrur., 1888, p. 487, pl. 87 (nomen præoccupatum).

Pontophilus batei Faxon, Bull. Mus. Compar. Zool., XXIV, August, 1893, p. 200, footnote (nomen præoccupatum).

Pontophilus challengerii Ortmann, Decapod. Schizop. Plankton Exped., 1893, (September) p. 49.

Geographical distribution: Atlantic, near Tristan da Cunha, 1900 fath. (Bate); Cape Verde Islands, ca. 2700 fath. (Ortmann); Pacific: New Zealand, 1100 fath. (Bate); near Torres Strait, 1400 fath. (Bate); near Philippine Islands, 2150 fath. (Bate).

11. *Pontophilus pattersoni* (Kinahan) 1862.

Cheraphilus pattersoni Kinahan, Proceed. R. I. Acad., Dublin, VIII, 1862, p. 69, 73, pl. 7.

Geographical distribution: Northern England and Ireland (Kinahan).

12. *Pontophilus sculptus* (Bell) 1853.

Crangon sculptus Bell, Hist. Brit. Crust., 1853, p. 263 (fig.). Henderson, Decapod. Schizop., Firth of Clyde, 1886, p. 32.

Geographical distribution England: Weymouth (Bell), Firth of Clyde, 20 fath. (Henderson).

13. *Pontophilus bidentatus* (de Haan) 1849.

Cranzon bidentatus de Haan, Faun. Japon. Crust., Dec. 6, 1849, p. 183, pl. 44, fig. 14.

Geographical distribution: Japan (de Haan).

14. *Pontophilus australis* (Thomson) 1878.

Cranzon australis Thomson, Trans. Proceed. New Zealand Inst., XI, 1878, p. 231, pl. 10, fig. A. 1. Filhol, Passage Venus., Miss. Campbell, 111, 2, 1885, p. 430.

Geographical distribution: New Zealand: Cook Straits, Dumedin, Stewart Isl. (Thomson), from Napier to Stewart Isl. (Filhol).

15. *Pontophilus junceus* Bate, 1888.

Bate, Challenger Macrur. 1888, p. 491, pl. 88, fig. 2-4.

Geographical distribution: Between Philippine Islands and Borneo, 250 fath. (Bate.)

16. *Pontophilus gracilis* Smith, 1882.

Smith, Bull. Mus. Comparative Zool., X, 1882, p. 36, pl. 7, fig. 2-3. Wood-Mason and Alcock, Annals and Mag. Nat. Hist. (6) VIII, 1891, p. 361.

Geographical distribution: Atlantic, eastern coast of United States, 225-458 fath. (Smith); Bay of Bengal, 561-683 fath. (Wood-Mason and Alcock).

17. *Pontophilus profundus* Bate, 1888.

Bate, Challenger Macrur. 1888, p. 490, pl. 88, fig. 1.

Geographical distribution: Off Sydney, 2600 fath. (Bate).

18. *Pontophilus bispinosus* Hailstone, 1835.

Pontophilus bispinosus Hailstone (nec Westwood), Mag. Nat. Hist., VIII, 1835, p. 271, fig. 30.

Crangon nanus Krøyer, Naturh. Tidsskr., IV, 1842, p. 231, pl. 4, fig. 15-28. Metzger, Jahresber. Comm. Unters. Deutsch. Meer., 11, III, 1875, p. 291. Meinert, Naturh. Tidsskr. (3) XI, 1877, p. 199. Henderson, Decap. Schiz. Firth of Clyde, 1886, p. 33. Scott, Annal. Mag. Nat. Hist. (6) XIII, 1894, p. 413.

Crangon bispinosus (Hailst.) Bell, Brit. Crust., 1853, p. 268.

Cheraphilus bispinosus (Hailst.) Kiuahan, Proceed. R. I. Acad., Dublin, VIII, 1862, p. 68, 72, pl. 5.

Geographical distribution: Northern Europe.—Sund (Meinert); Kattegat (Krøyer); Skagerrak, 10-110 fath. (Meinert); Norway (G.

O. Sars); North Sea (Metzger, Scott); England (Bell, Kinahan, Henderson).

19. *Pontophilus intermedius* (Bate) 1863.

Cragon intermedius Bate, Proceed. Zool. Soc., London, 1863, p. 503, pl. 41, fig. 6. Haswell, Catal. Austral. Crust., 1882, p. 181.
Cragon batei Kingsley, Bull. Essex Inst., 14, 1882, p. 129.

Geographical distribution: Australia, Gulf St. Vincent (Bate).

20. *Pontophilus trispinosus* Hailstone, 1835.

Pontophilus trispinosus Hailstone, Mag. Nat. Hist., VIII, 1835, p. 261, fig. 25. Ortmann, Zoolog. Jahrb., IV, 1890, p. 533.
Cragon trispinosus (Hailst.) Bell, Brit. Crust., 1853, p. 265. Metzger, Jahresb. Comm. Unters. Deutsch. Meer., II, III, 1875, p. 291. Carus, Prodr. faun. Medit., I, 1884, p. 482.
Cheraphilus trispinosus (Hailst.) Kinahan, Proceed. R. I. Acad., Dublin, VIII, 1862, p. 69, 72, pl. 6.

Geographical distribution: North Sea, 10–22 fath. (Metzger); England and Ireland (Kinahan); Marseille (Gourret); Azores (Barrois).

21. *Pontophilus fasciatus* (Risso) 1816.

Cragon fasciatus Risso, Hist. Nat. Crust., Nice, 1816, p. 82, pl. 3, fig. 5. Risso, Hist. Nat. Europ. mérid., V, 1826, p. 64. Milne-Edwards, Hist. Nat. Crust., II, 1837, p. 342. Bell, Brit. Crust., 1853, p. 259. Heller, Crust. südl. Europ., 1863, p. 228, pl. 7, fig. 10. Carus, Prodr. faun. Medit., I, 1884, p. 483. Norman, Annal. Magaz. Nat. Hist. (5) XIX, 1887, p. 90.
Aegeon fasciatus (Riss.) Kinahan, Proceed. R. I. Acad., Dublin, VIII, 1862, p. 69, 74, pl. 9. Ortmann, Zoolog. Jahrb., IV, 1890, p. 535.

Geographical distribution: European Seas (Northern Europe, Mediterranean Sea) and Azores. (See Ortmann, l. c.).

22. *Pontophilus neglectus* (G. O. Sars) 1882.

Cheraphilus neglectus G. O. Sars, Forh. Vid. Selsk., Christiania, 1882, No. 18, p. 45, Pl. 1, fig. 7. G. O. Sars, Den Norsk. Nordh. Exp., Zool., Crust., II, 1886, p. 6.

Geographical distribution: Norway, 2–6 fath. (G. O. Sars).

23. *Pontophilus carinicauda* (Stimpson) 1860.

Cragon carinicauda Stimpson, Proceed. Acad. Nat. Sci. Philadelphia, 1860, p. 25.

Geographical distribution: Hong Kong (Stimpson).

SABINEA Owen, 1835.

Owen, Append. Voy. Capt. Ross, 1835, p. 82. Kingsley, Proceed. Acad. Nat. Sci. Philadelphia, 1879, p. 412.

Second pereopoda very short, without chela. Gills seven, like *Pontophilus*, or five pleurobranchiæ and two arthrobranchiæ (see Smith, *Sabinea hystrix*). Eyes present, free.

- a₁. Rostrum short, scarcely longer than the eyes.
 b₁. Rostrum and telson blunt *S. septemcarinata* (6).
 b₂. Rostrum and telson more acute *S. sarsi*.
 a₂. Rostrum long, about as long as the antennale scale . . . *S. hystrix*.

1. *Sabinea septemcarinata* (Sabine), 1824.

Crangon septemcarinatus Sabine, Suppl. Append. Parry's Voy. 1824, p. 236, pl. 2, fig. 11-13. Milne-Edwards, Hist. Nat. Crust. II, 1837, p. 343.
Sabinea septemcarinata (Sab.) Krøyer, Naturh. Tidsskr. IV, 1842, p. 244, pl. 4, fig. 34-40, pl. 5, fig. 41-44. Metzger, Jahresb. Comm. Unters. deutsch. Meer. II, III, 1875, p. 291. Miers, Ann. Mag. Nat. Hist. (4) XX, 1877, p. 58. Kingsley, Bull. Essex Inst. X, 1878, p. 55. Smith, Trans. Connect. Acad., V, 1879, p. 57, pl. 11, fig. 5, 9, 13. Hoek, Nederl. Arch. Zool., Suppl. 1, 7, Crust. 1882, p. 12. G. O. Sars, Den Norsk. Nordh. Exp. Zool. Crust. II, 1886, p. 7. Stuxberg, Vega Exped., V, 1887, p. 54. Bate, Challenger Macrur. 1888, p. 493, pl. 89, fig. 2, pl. 90, fig. 1. Ortman, Zoolog. Jahrb., V, 1890, p. 536.

Geographical distribution: Arctic seas extending southward into boreal seas.—Norway, to 106 fath. (M. Sars, Metzger); Barents Sea and Nowaja Semlja, 37-160 fath. (Hoek); Spitzbergen (Krøyer, G. O. Sars); Iceland (Krøyer); Greenland (Reinhardt, Lütten); Davis Strait (Sabine); Grinnell Land (Miers); N. E. coast of America: from Gulf of St. Lawrence to Massachusetts Bay, 25-85 fath. (Smith, Bate); Arctic coast of Siberia (Stimpson, Stuxberg).

2. *Sabinea sarsi* Smith, 1879.

Smith, Trans. Connect. Acad., V, 1879, p. 59, pl. 11, fig. 6, 7, 8. G. O. Sars, Forh. Vidensk. Selsk. Christiania, 1882, No. 18, p. 46. Smith, Rep. U. S. Fish Comm. f. 1882, 1884, p. 364.

Geographical distribution: Northeastern coast of America, 60-150 fath. (Smith); Norway: Lofoten (Smith), Christianssund and Stavanger (G. O. Sars).

3. *Sabinea hystrix* (A. Milne-Edwards), 1881.

Paracrangon hystrix A. Milne-Edwards, Annal. Sci. Natur. (6) Zool. XI, 1881, p. 6.
Sabinea princeps Smith, Bull. Mus. Comp. Zool. X, 1882, p. 38, pl. 8, fig. 1. Smith, Rep. U. S. Fish Comm. f. 1882, 1884, p. 364.

Geographical distribution: Atlantic: eastern coast of United States, 464-888 fath. (Smith); Guadeloupe, 734 fath. (A. Milne-Edwards).

PRIONOCRANGON Wood-Mason and Alcock, 1891.

Wood-Mason and Alcock, Annal. Mag. Nat. Hist. (6) VIII, 1891, p. 361.

Second pereopoda present, without chela, rather robust with a fringe of long hairs. Eyes and eye-stalks wanting. Carapace with a spiny median keel.—Gills unknown.

Only one species known.

1. *Prionocrangon ommatosteres* Wood-Mason and Alcock, 1891.

Wood-Mason and Alcock l. c. p. 362. Alcock and Anderson, Jour. Asiat. Soc. Bengal, Vol. 63, 2, 1894, p. 152.

Geographical distribution: Bay of Bengal, 200–405 fath. (Wood-Mason, Alcock, and Anderson).

PARACRANGON Dana, 1852.

Dana, U. S. Explor. Exped. Crust. 1852, p. 537. Kingsley, Proceed. Acad. Nat. Sci., Philadelphia, 1879, p. 412.

Second pereopoda wanting. Eyes present, free. Carapace with long spines.—Gills unknown.

- a₁. Branchial regions not areolate, five—spinous *P. echinatus*.
 a₂. Branchial regions traversed by anastomosing ridges, dividing these regions into cells of different sizes; they are armed with three small spines *P. arcolatus*.

1. *Paracrangon echinatus* Dana, 1852.

Dana, U. S. Explor. Exped. Crust. 1852, p. 538, pl. 33, fig. 6. Stimpson, Boston Jour. Nat. Hist. VI, 1857, p. 497. Kingsley, Bull. Essex Instit. X, 1878, p. 55.

Geographical distribution: W. coast of North America: Puget Sound, Oregon (Dana).

2. *Paracrangon areolatus* Faxon, 1893.

Paracrangon arcolata Faxon, Bull. Mus. Comp. Zool. XXIV, 1893, p. 200.

Geographical distribution: Western coast of Mexico: Tres Marias Islands, 676–680 fath. (Faxon).

Considerations concerning the geographical distribution of the Crangonidae.

The geographical distribution of the *Crangonidae* shows that only one genus, *Pontocaris*, no doubt the most primitive, is a true inhabitant of the lesser depths of the tropics, the two species known being found in 49 and 140 fathoms in the Indo-Malaysian seas. All the other genera are partly confined to the seas of temperate or cold climates, partly there is the main range, and only a few species are present in the litoral of warmer climates. *Pontocaris*, I believe, must be regarded as a survival in the tropics, and its occurrence in somewhat deeper water, but within the limits of the litoral, shows already the tendency to descend into greater depths developed in many species of the other *Crangonidae*. None of the other species present in the tropical parts of the world can be regarded as survivals; they immigrated thither from the more northern localities.

The main range of the genus *Crangon* comprises the cooler seas of the northern hemisphere both in the Atlantic and Pacific. There are three species showing a true circumpolar distribution: *Cr. salebrosus*, *boreas* and *crangon*. The two first named must be regarded as true arctic animals, extending southward, it is true, in more temperate climates, but preferring considerable depths, from about 100 to 400 fathoms. *Crangon crangon* lives in very shallow water, extending not as far northward as *Cr. salebrosus* and *boreas*, and a connection between the Atlantic and Pacific (Japanese) localities is not known. Perhaps such a connection was only present in former times, and this species can not be counted among the circumpolar ones, but is a survival of a formerly more extended distribution. The two varieties of *Crangon crangon* described above prefer deeper water, 50 and 60 fathoms, and they are restricted to one of the northern parts of the two great oceans, *affinis* being found in the northern Pacific from Japan to California, *allmanni* in northern Europe. Of the other species of *Crangon* eight show a distribution similar to the two last varieties. Five are litoral and restricted to the northern part of the Pacific, especially *Cr. sharpi* and *intermedius* to the most northern parts (Berings Sea and Alaska), *Cr. angusticauda* to Japan, and *Cr. minutus* and *franciscorum* to the western coast of United States. The latter replaces the typical *Cr. crangon* on this coast. A sixth species, *Cr. agassizi*, is found in the Atlantic near the eastern coast of United States, and must be regarded as a true deep sea animal, being recorded from about 200 to 900 fathoms. It is replaced on the western side of America by a nearly allied abyssal species, *Cr. procax*, 660-900 fathoms. On the western coast of Central America is found a second abyssal species, *Cr. atrox*, between 600 and 700 fathoms, being closely related to the northern circumpolar *Cr. salebrosus*. The presence of these three abyssal species on both sides of the American continent indicate a relation to the northern circumpolar seas, according to their affinities with the northern circumpolar species of the subgenus *Scleroerangon*, but I do not believe that this demonstrates the connection of the western and eastern American seas in the tertiary period within the litoral, as held to-day generally by authors.

Finally there are two antarctic species: *Cr. capensis* from the Cape of Good Hope, and *Cr. antarcticus* from South Georgia. The latter

is regarded by Pfeffer¹¹ as a proof of the bipolar distribution of *Crangon*. I have doubted the correctness of Pfeffer's opinion in this view,¹² and have pointed out that the examples of bipolar distribution of crustacea enumerated by him do not correspond exactly to the facts known, except in the case of *Cr. antarcticus*. But neither in this species, is, I believe, a bipolarity of the genus probable. *Cr. antarcticus* is the nearest allied to *Cr. franciscorum* and this fact induces me to suppose that a connection between the northern and southern range of *Crangon* is present along the west coast of America from California to Chili, and in the same manner, I believe, there is a connection from the European seas along the western coast of Africa to the Cape of Good Hope, the locality of *Cr. capensis*. Litoral species of *Crangon* have not yet been recorded from the western coasts of America and Africa, but I hope that further investigation will demonstrate the presence of this genus in both localities, and thus strengthen my theory.

Supposing my theory to be correct, the range of *Crangon* would be a northern circumpolar one, partly containing circumpolar species, partly species confined to the northern parts either of Pacific or of Atlantic. Some species descended into the deep sea to a depth of about 900 fathoms and could propagate more southward. Along the west coasts of Africa and America, owing to the cooler temperature of the seas on these coasts, the range of *Crangon* could extend to the southern hemisphere, crossing the tropics.

The range of the genus *Nectocrangon*, the nearest allied of *Crangon*, agrees wholly with that of the northern species of *Crangon*: one species, *Nectocrangon lar*, is a true arctic-circumpolar one extending very little southward (the most southern locality recorded is Nova Scotia), the other, *Nectocrangon alaskensis*, is restricted, as we know, at present to Alaska.

The genus *Pontophilus*, the first of the series, representing the second branch of development arising from *Pontocaris*, has a nearly cosmopolitan horizontal distribution, but the several species are wholly different from each other. The greatest number of species, like *Crangon*, is found in the litoral of the cooler seas of the northern hemisphere,

¹¹ Pfeffer, Die niedere Thierwelt des antarctischen Ufergebietes.—Internat. Polarf. Deutsch. Exped. II, 1890, p. 520-572.

¹² Ortmann, Jenaische Denkschriften, VIII, 1894, p. 77.

but their range does not extend very far northward. Accordingly, arctic circumpolar species are not known, the northern litoral species being restricted to comparatively narrow districts, each to one side of the great oceans. Only one species, *P. norvegicus*, in the northern Atlantic, is found on both the European and American shores. Eight species are found in the European seas: *P. echinulatus*, *spinosus*, *pattersoni*, *sculptus*, *bispinosus*, *trispinosus*, *fasciatus*, *neglectus*; one on the east coast of United States: *P. brevirostris*. As the cooler waters of the western African coast allow a more southward extension, a mediterranean species, *P. cataphractus*, ranges southward to the Senegambia. In the Pacific northern species are not known, but two having a more southward range: *P. bidentatus* in Japan, *P. carinicauda* in China. The presence of the latter in the tropics is due, I believe, to a more recent immigration. Of the northern litoral species some show a very large bathymetrical range, descending to considerable depths, especially *P. echinulatus*, *brevirostris* to 150 fathoms, *P. norvegicus* to 500 fathoms. The next to the latter species, as regards the depth inhabited, are *P. bengalensis*, *andamanensis*, *junceus*, being found in the tropical seas of India and Indo-Malaysia in depths of about 100 to 300 fathoms, and, farther, five species are true deep sea animals. One of these, *P. profundus*, is only found near Sydney in 2,600 fathoms, another, *P. occidentalis*, off the west coast of Central America in 900–2,200 fathoms. The three others show the characteristic wide range of the true abyssal animals, *Pont. gracilis* being found in the Atlantic and Indian oceans from 200 to 700 fathoms, *P. abyssi* in the North Atlantic and Indian oceans from 1700 to 2,200 fathoms, and *P. challengeri* in the Atlantic and Pacific oceans from 1,100 to 2,700 fathoms. Lastly, two litoral species are known from the cooler seas of the southern hemisphere: *P. australis* from New Zealand, and *P. intermedius* from Southern Australia.

The horizontal and vertical range of *Pontophilus* may be summarized as follows: The main distribution of the genus is in the litoral of the northern hemisphere, especially in the temperate seas, a circumpolar range of none of the species is proven; a few litoral species extend more southward. A great number of species have a tendency to descend into deeper water, and, accordingly, some species are found in the deeper water even of the tropics, and have occupied a large area of the deep sea. In the cooler parts of the

southern hemisphere is given the possibility to re-ascend into the litoral, and two litoral species are, in fact, found in Australia and New Zealand.

The genus *Sabinea* contains two northern species, one of which, *S. septemcarinata*, is a true arctic circumpolar one, the other, *S. sarsi*, is found on both sides of the northern Atlantic. Both descend into greater depths, to about 150 fathoms. The third species, *S. hystrix*, is an abyssal one, found in 400 to nearly 900 fathoms, and its range extends more southward, from the eastern coast of United States to Guadeloupe in the West Indies.

The two known species of the most extreme genus of the second branch of Crangonidæ, *Paracrangon*, live on the western coasts of America, probably in greater depths; at least *P. areolatus* is recorded from over 600 fathoms.

The last genus, *Peionocrangon*, is very peculiar and its affinities are not certainly known. It probably is allied to *Pontophilus*, and then its habitat, in the deep sea of the Indian ocean, 200-400 fathoms, would not be strange, since *Pontophilus* contains also tropical species living in deeper water.

The distribution of *Crangonidæ* may be thus summarized:

The "regions of life"¹³ in which Crangonidæ are found, are the *litoral* and the *abyssal*. Regarding the "facies,"¹⁴ the Crangonidæ are principally, as we know, *benthonic*¹⁵ in sand and mud. These habits admit a universal distribution of the family, but the genera and species are more restricted.

The litoral species especially are not cosmopolitan, but are confined by barriers. Except the tropical genus *Pontocaris*, which must be regarded as a survival, the litoral Crangonidæ are almost exclusively limited to the northern hemisphere, and the seas of tropical temperature must be considered as the *climatic barrier* preventing the distribution of Crangonidæ southward. Only a few species are adapted to the warmer seas, especially *Crangon cataphractus* in Senegambia and *Pontophilus carinicauda* in China. Generally, the Crangonidæ, originating in the cooler northern hemisphere, were

¹³ "Lebensbezirke," J. Walther, *Bionomie des Meeres*, 1893, p. 13-15, p. 87-176.—Walther does not give a satisfactory and correct definition of this word, on account of which his detailed discussion concerning this term is wholly out of place. Notwithstanding, the idea of "regions of life" is a very good one.

¹⁴ Walther, *ibid.* p. 25-34.

¹⁵ See Haeckel, *Planktonstudien*, 1890, p. 18ff.

separated from the cooler parts of the southern by the broad belt of the warm circumtropical seas. This zone, however, is not a continuous one, but is interrupted within the litoral on two tracts, on the western coasts of Africa and America. At these two localities there are two causes producing a lower temperature of the litoral seas than is usual in the tropics. On the one hand, there are cold currents running from the southern cold seas along both shores northward as far as the equator and even beyond; on the other hand, on these coasts arises cold water from the sea-bottom, the equatorial currents directed from the coast to the west carrying away the surface water. A cooling of the litoral waters of the west coasts of Africa and America is thus produced, and although the most superficial layers of water may be warmed by the sun, in greater depths within the litoral there may prevail a low temperature. Thus, on the west coasts of Africa and America, it may be possible that northern litoral forms penetrate into the tropics and beyond, and may reach the litoral of the cooler antarctic hemisphere. The presence of *Crangon capensis* and *C. antarcticus* may be thus explained.

By adaption to a cooler temperature a large number of Crangonidae are able to descend to greater depths,¹⁶ and by this habit they may enter and cross the tropics in the deep sea. The species adapted to the greater depths show, as usually in deep sea animals, a very large horizontal range, and, therefore, they can reach the southern hemisphere, while a re-ascending into the litoral of the antarctic regions is possible. We know of the genus *Pontophilus*, which is the only one containing true deep sea species of wide distribution, two species in southern Australia and New Zealand, the presence of which is probably due to this cause.

Other barriers against the distribution of the species of Crangonidae are of a *topographical* character. At first, the great continents of northern Eurasia and North America cause a complete separation of the northern temperate parts of the Atlantic and Pacific, and, therefore, these oceans contain distinct species. Farther, the Crangonidae, living mostly benthonic, can not pass over great oceans, and, accordingly, the eastern and western shores both

¹⁶ The cold temperature is the main cause favoring immigration in the deep seas, and in the arctics the deep sea and the litoral are closely connected. See Monaco, *Zur Erforschung der Meere*, etc., translated into German by Marenzeller, Wien, 1891, p. 135, and Pfeffer, *Versuch über der erdgeschichtliche Entwicklung der jetzigen Verbreitungsverhältnisse unserer Tierwelt*, Hamburg, 1891.

of the Pacific and Atlantic are inhabited by different species. Only the true arctic species being able to live along the most northern shores of America and Asia show a circumpolar distribution, no topographic barriers of the kind mentioned there being present. The species not living in the arctic, but in the boreal¹⁷ seas, are restricted by such topographic barriers.

It is evident, therefore, that the means of dispersal of the Crangonidæ, except *Pontocaris* and a few species of *Pontophilus*, do not act against the climatic barriers and mostly also not against the topographic. Only a few known species are present on both shores of the Atlantic: *Pontophilus norvegicus* (100–150 fath.) and *Sabinea sarsi* (60–150 fath.). Whether these species can pass over the barrier formed by the northern Atlantic as adult animals or as larvæ, or whether this distribution is due to other causes, we can not say at present.

On the shores of the Atlantic and Pacific very nearly allied species are sometimes found. These must be derived from common ancestors living when the arctic ocean was not as cold as at present, and when a circumpolar connection was present for these species as in the case of the circumpolar forms now living. Later these species retreated more southward, and by the topographic separation of the range, the morphological characters could change, and distinct forms could develop.

The geographical distribution of the Crangonidæ is a very characteristic one and important as limiting the northern zoo-geographical regions of the litoral. Apart from a few species living in the tropics, in the antarctic and in the deep sea, the family of Crangonidæ characterizes the *northern circumpolar region*, as defined by me formerly.¹⁸ This region is characterized by the genera *Nectocrangon* and *Sabinea*. Among the northern species we can distinguish true arctic species showing a circumpolar range, especially *Crangon salebrosus*, *boreas*, *Nectocrangon lar*, *Sabinea septemcarinata*, and boreal species. The latter are not circumpolar, but more restricted. *Crangon crangon affinis* is restricted to the Pacific, *Pontophilus norvegicus* and *Sabinea sarsi* to the Atlantic. The other species are more localized and characterize each a separate local fauna, and we can distinguish a Japanese fauna, a fauna of the Berings Sea, a fauna of the western coast of

¹⁷ Regarding the distribution of "arctic" and "boreal" seas see Pfeffer, Versuch, etc., 1891.

¹⁸ Jenaische Denkschriften, VIII, 1894, p. 78.

America. Characteristic of the first is *Crangon angusticauda*; *Pontophilus bidentatus*; of the second, *Crangon sharpi*, *C. intermedius*, *Nectocrangon alaskensis*; of the third, *Crangon munitus*, *C. franciscorum*, *Paracrangon echinatus*.¹⁹ In the Atlantic, we have species peculiar to the European coasts: *Crangon crangon allmanni*, *Pontophilus echinatus*, *P. spinosus*, *P. pattersoni*, *P. sculptus*, *P. bispinosus*, *P. trispinosus*, *P. fasciatus*, *P. neglectus*, and one peculiar to the east coast of America: *Pontophilus brevirostris*.

Accordingly, within the limits of the arctic region we can distinguish three sub-regions: 1. The *arctic-circumpolar*; 2. the *Atlantic-boreal*; 3. the *Pacific-boreal*. The two latter are divided into local faunas, the Atlantic into the northern European and the fauna of the east coast of United States; the Pacific into the local faunas of the Berings Sea, of Japan, and of the west coast of North America.

The arctic litoral region is the centre of origin of the family of Crangonidæ, and the centre of its development. The geographical distribution of the species not living within the arctic litoral may be characterized and classified as follows:

1. Survivors of a more cosmopolitan distribution in the tropics of Indo-Malaysia: *Pontocaris propensalata*, *P. pennata*.

2. Immigrants into the litoral of warmer seas from the northern litoral: *Pontophilus cataphractus*, *P. carinicauda*.

3. Immigrants into the deep sea.

a. Localized species.²⁰ North Atlantic: *Crangon agassizi*, 200-900 fath., *Subinea hystrix*, 400-900 fath.; Indo-Malaysia: *Pontophilus bengalensis*, 107-270 fath., *P. andamanensis*, 180-220 fath., *P. junceus*, 250 fath., *Prionocrangon ommatosteres*, 200-400 fath.; off Australia: *Pontophilus profundus*, 2600 fath.; off western coast of Central America: *Crangon atrox*, 600-700 fath., *Cr. proceax*, 600-900 fath., *Pontophilus occidentalis*, 900-2200 fath., *Paracrangon areolatus*, 670-680 fath.

b. Widely distributed abyssal species: *Pontophilus gracilis*, 200-700 fath., *Pontophilus abyssi*, 1700-2200 fath., *Pontophilus challengerii*, 1100-2700 fath.

4. Immigrants into the litoral of the antarctic region.

Crangon antarcticus, *Cr. capensis*, *Pontophilus australis*, *P. intermedius*.

¹⁹ *Paracrangon echinatus* is perhaps an abyssal species, judging from the depth recorded for *Paracrangon areolatus*.

²⁰ Some of these species may be more widely distributed.

The occurrence of the recently described *Aegeon orientalis* Henderson, from the litoral of the Burmese coast (Gulf of Martabem) is remarkable, because this species is said to be related to the Mediterranean *Pontophilus cataphractus*. It may, however, belong to the genus *Pontocaris*, and the description and figure given by Henderson do not refute this supposition.